FOCUS ON SCIENCE

Earth Science

Water

Advanced Level

Water Is in the Air

LOOK INSIDE FOR:

- Core Curriculum Covered
- Student Book
- Assessments and Reading Activities

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Water Is in the Air

What makes water so special?

CORE CURRICULUM STATEMENTS

Many of the phenomena that we observe on Earth involve interactions among components of air, water, and land.

Water is recycled by natural processes on Earth.

- evaporation: changing of water (liquid) into water vapor (gas)
- condensation: changing of water vapor (gas) into water (liquid)
- precipitation: rain, sleet, snow, hail
- runoff: water flowing on Earth's surface
- groundwater: water that moves downward into the ground

Plants and animals depend on each other and their physical environment.

Heat energy from the Sun powers the water cycle.

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Water Is in the Air

by Caitlin Scott

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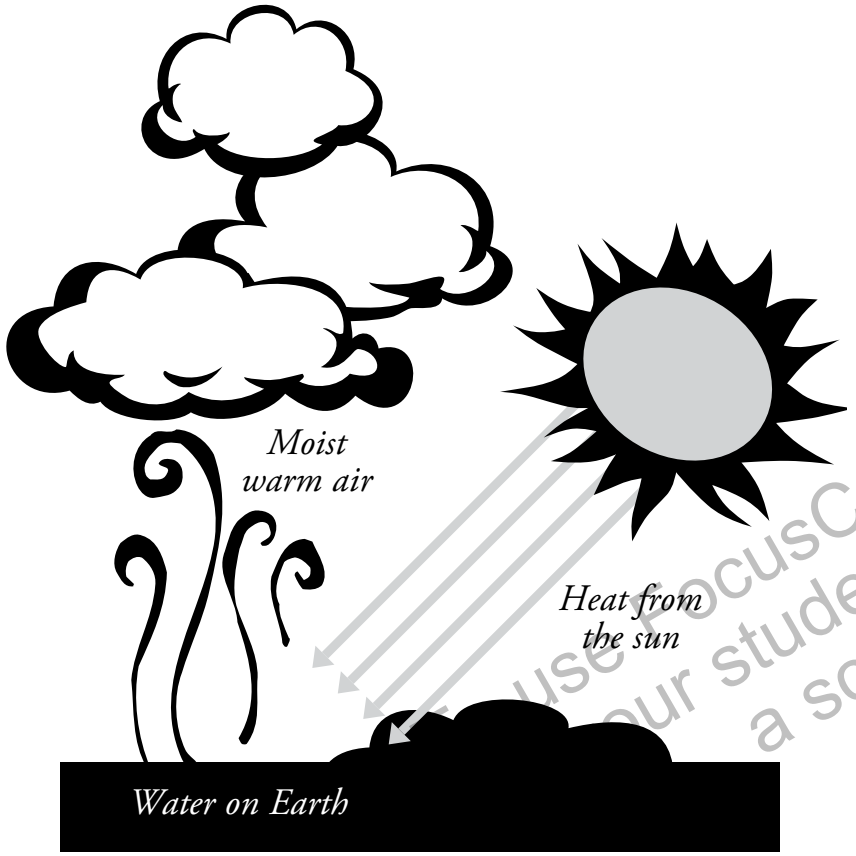
Curriculum materials for **your** content standards

Table of Contents

– Predict –
What do you think you will learn from reading this book?



Clouds form when warm, moist air rises off Earth's surface.

Clouds Are Water

Air surrounds us, filling every nook and cranny. Even though air is invisible, we know it exists because we breathe it every day. Air is made of **gases**, such as nitrogen, oxygen, argon, and carbon dioxide. Air also contains water **vapor**. How do we know this? When we notice clouds in the sky, we are really seeing water in the air.

When water is warmed by the sun, it evaporates and rises. As water vapor rises, it cools and tiny water droplets form. When these droplets are packed closely together, they become visible and form a cloud. When too much water collects in a cloud, the cloud can no longer contain all the water and it falls.

Water goes up into the air and falls back to Earth all the time. This process is called the water cycle. The sun is the source of energy for the water cycle.

gases: matter that has no shape; gases spread out to fill the space around them; most cannot be seen
vapor: a gas formed from something that is usually a liquid

CHAPTER 1

The Water Cycle

The water cycle has five parts, each of which is essential to life on Earth.

Evaporation—Radiation from the sun warms water on the surface of the Earth. Gradually, the water changes state from a liquid to a gas and rises. Often the water vapor forms clouds.

Transportation—Clouds are transported, or moved, by wind over land.

Condensation—When the warm gas rises and moves over land, the air cools and the gas changes state again back to a **liquid**. Tiny water droplets form clouds.

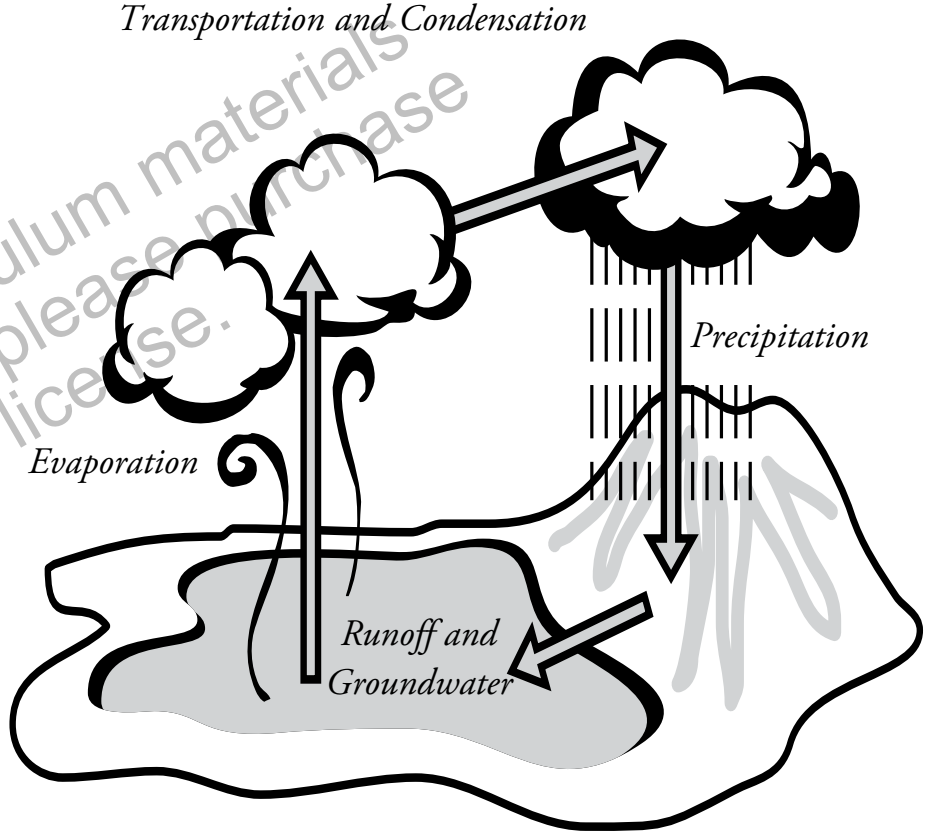
Precipitation—More and more water collects in the cloud. Eventually, when there is enough water, it falls back to Earth's surface.

Runoff and Groundwater—The water that falls from the cloud collects on Earth in lakes, rivers, and oceans, and some is absorbed into the ground.

Can you guess what happens next?

liquid: a state in which matter flows freely when poured; liquids take the shape of whatever holds them

Water Cycle



– Recall –
Name the five parts of the water cycle.

Evaporation

Evaporation occurs when water on Earth's surface is warmed by the sun. The water is transformed from a liquid to a gas. As a gas, water travels up into the air.

Remember a time when you spilled water on your clothes? Eventually, the spot dried and disappeared. The liquid water was transformed into a gas through evaporation, even though you didn't see the water going into the air.

Why does the ground dry out? The ground becomes dry and dusty because the water evaporates. Even though you can't see it, water evaporates all the time.

Have you seen a pot of boiling water? You see steam rising out of the pot. First, water evaporates from a liquid to a gas. Then, a cloud forms through condensation. Read on to learn more about condensation.

– Explain –
What causes water to evaporate?

When water boils, it turns from a liquid to a gas. You can see the gas as steam.

– Apply –
Describe evidence of the water cycle that you have seen.

Transportation

Most water vapor is evaporated from bodies of water such as the ocean or lakes. Wind transports the water vapor toward land, which is higher than the body of water.

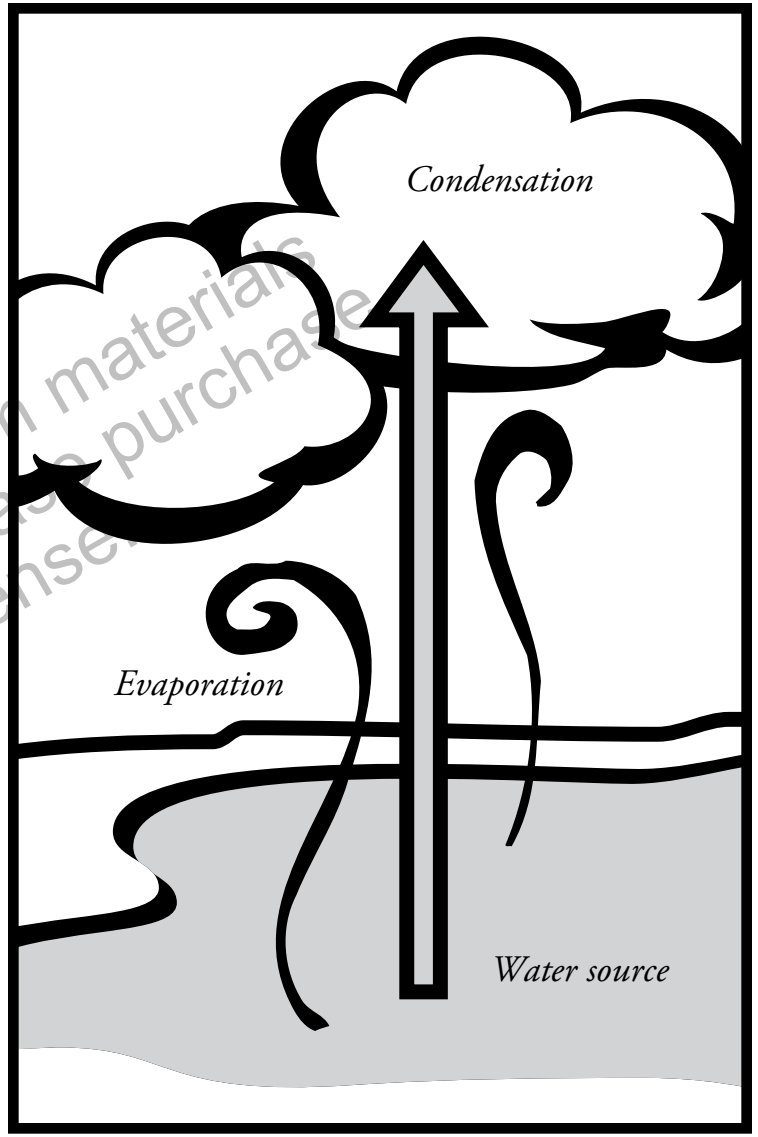
Condensation

Have you ever exhaled gently on a cold window? Your warm breath created fog on the surface of the window. This happened through a process called condensation.

Condensation occurs when water vapor is pushed higher and begins to cool. The vapor changes back to liquid water, forming a cloud. This is an important part of the water cycle. First water evaporates; then, it condenses. Eventually, the condensation forms clouds.

What happens next in the water cycle? When the water in the clouds gets too heavy, the water falls back to Earth.

– Explain –
What happens when water condenses?



Precipitation

Water can't stay suspended in the air in clouds forever. As the clouds move higher, they get colder and more gas becomes liquid. The liquid water is heavier than water vapor. It falls back to Earth.

Rain

If it is warm outside, the water, or precipitation, that falls is rain. Rain occurs at temperatures that are above freezing. This means greater than 32 degrees Fahrenheit or 0 degrees Celsius.

In some parts of the United States, it rains a lot, but in other parts, it is very dry. For example, Astoria, Oregon is one of the rainiest cities in the United States, while Las Vegas, Nevada is located in a desert and gets very little rain.

Average Rainfall in U.S. Cities	
City	**Average Annual Rainfall in Inches**
Astoria, Oregon	70
El Paso, Texas	8
Las Vegas, Nevada	4
Miami, Florida	60
New Orleans, Louisiana	60
Phoenix, Arizona	7

Snow

Snow is water that freezes while it is still in a cloud. As it falls to Earth's surface, it remains frozen. Because water freezes in a cloud and stays frozen as it falls, each flake has a beautiful, unique pattern. The patterns are created by the air that mixes with the cloud when the water freezes.

We have heavy snowfall in the northern parts of the United States. Snow can also be heavy in higher elevations, such as in the Sierra Nevada and Rocky Mountains.

Snowiest U.S. Cities	
City	**Average Annual Snowfall in Inches**
Blue Canyon, California	241
Marquette, Michigan	129
Sault Ste. Marie, Michigan	117
Syracuse, New York	112
Caribou, Maine	110

– Infer –
Why do scientists keep records of precipitation?

Sleet

Sleet is also precipitation that freezes inside a cloud. However, unlike snow, sleet doesn't stay frozen. Instead, sleet travels through warmer air, gradually melting as it falls. Then, it goes through colder air again as it approaches the ground just above Earth.

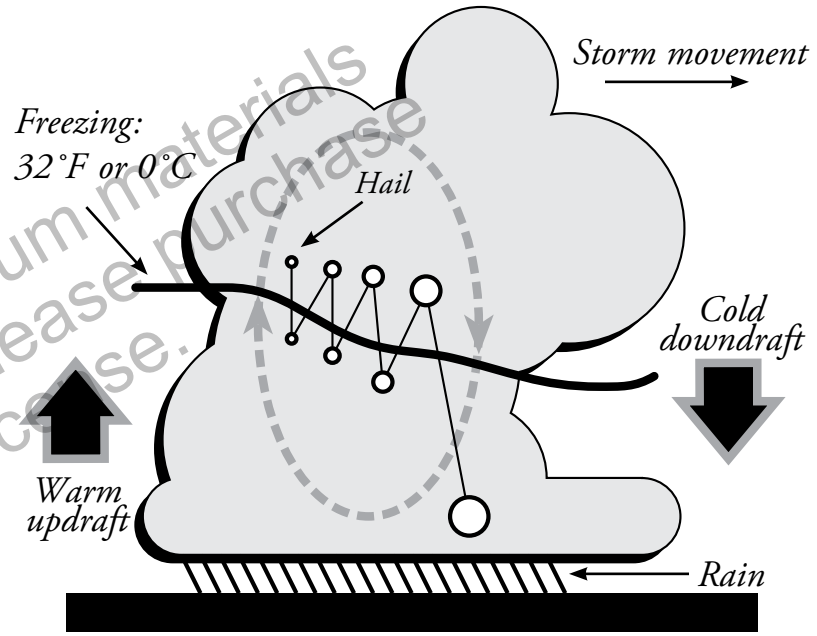
Air is not captured in sleet the way it is in snow. Instead, sleet is a drop of ice.

Hail

Hail is somewhat like sleet in that it forms when water drops freeze inside a cloud and falls through warmer air. As the water falls, it starts to melt, but strong updrafts from a **thunderstorm** blow it back up to the colder air. It collects dust and ice from the cloud and freezes once again. The frozen water falls again, and another updraft may blow it up again. This melting and refreezing cycle can occur many times. Each time, the frozen water drop gets larger, until it gets too heavy to stay up and falls to Earth as hail.

thunderstorm: a rainstorm that has thunder and lightning

How Hail Forms



Hail moves up and down in a storm cloud. It grows larger and larger each time it passes through air that is above and below freezing.

– Summarize –
Describe how water changes from one state to another.

Runoff and Groundwater

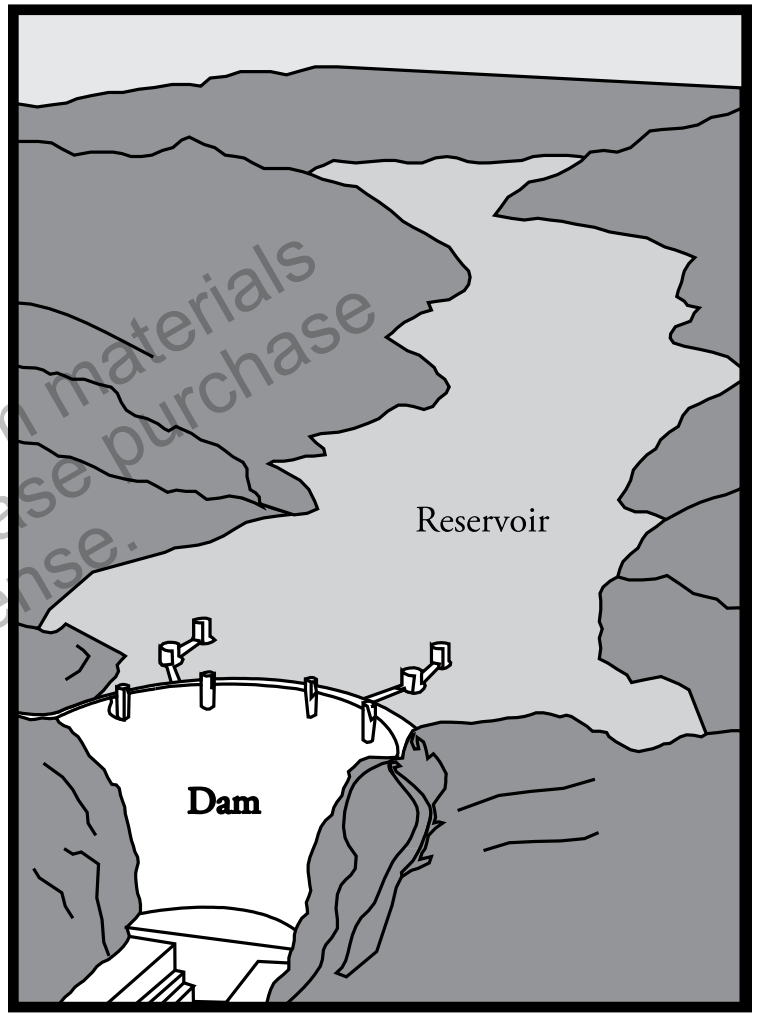
The last step of the water cycle is runoff and groundwater. When precipitation falls to the ground, it is absorbed, collected, and stored until it evaporates again.

Where do you imagine you can see water stored on Earth? The first location you think of might be a lake, a river, a sea, or the oceans, and any of these would be correct.

Water can also be stored underground. After an especially hard rain, the ground is damp and muddy because the ground is storing water. When the ground becomes saturated with water, the stored water can even form underground lakes or streams.

Sometimes engineers build **reservoirs** to collect and store water and purify the water for drinking, cooking, and cleaning. Lake Mead in Arizona and Nevada is the largest man-made reservoir in the United States—about 110 miles long.

reservoirs: places where water is stored



Lake Mead in Arizona and Nevada is a reservoir created by the Hoover Dam.

CHAPTER 2

The Water Cycle Never Stops

Evaporation, condensation, transportation, precipitation, and runoff and absorption into the ground are the five essential steps in the water cycle.

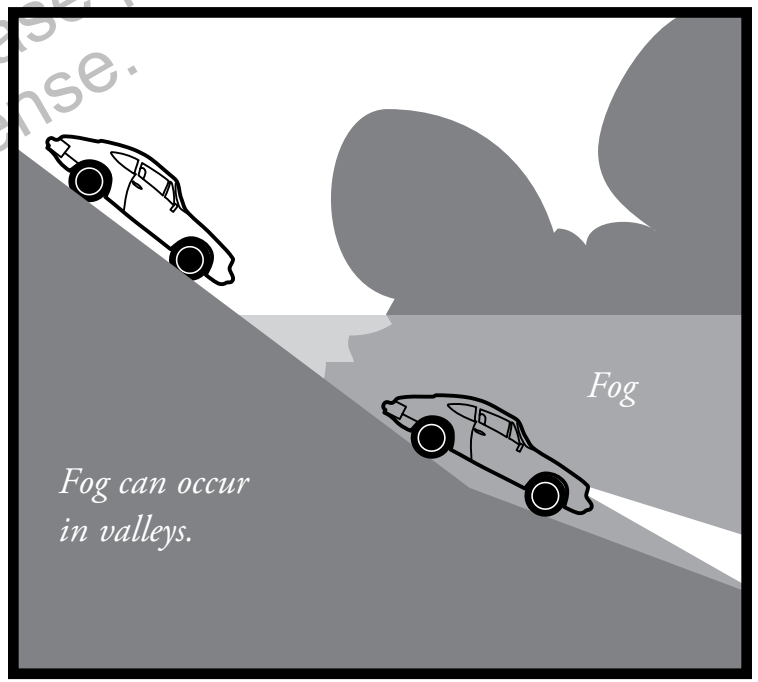
Water has been moving through the water cycle as long as Earth has existed. This means that the water in your glass once fell as rain, and the rain that falls today has been around since the time of the dinosaurs.

Because of energy from the sun, the water cycle is going on right now. Just like air, we can't always see water, but we know it's there. If we are lucky the water cycle will continue long into the future. We can't live without it.

In fact, all living things depend on the water cycle. Plants need water for their seeds to germinate and grow into mature plants. Many animals, such as you, eat plants to survive. Like plants, animals need water to drink. Other animals eat these animals to survive. They also need water to drink. Without the water cycle, this food chain would not exist

Did You Know?

Clouds don't always occur at high altitudes. In fact, sometimes clouds can touch the ground. We call these very low-lying clouds fog. Fog often occurs early in the morning in areas near large bodies of water, such as bays or lakes. Fog can also occur in valleys when heavy cold air sinks into the valley and warmer air passes over top.



CHAPTER 3

Try This

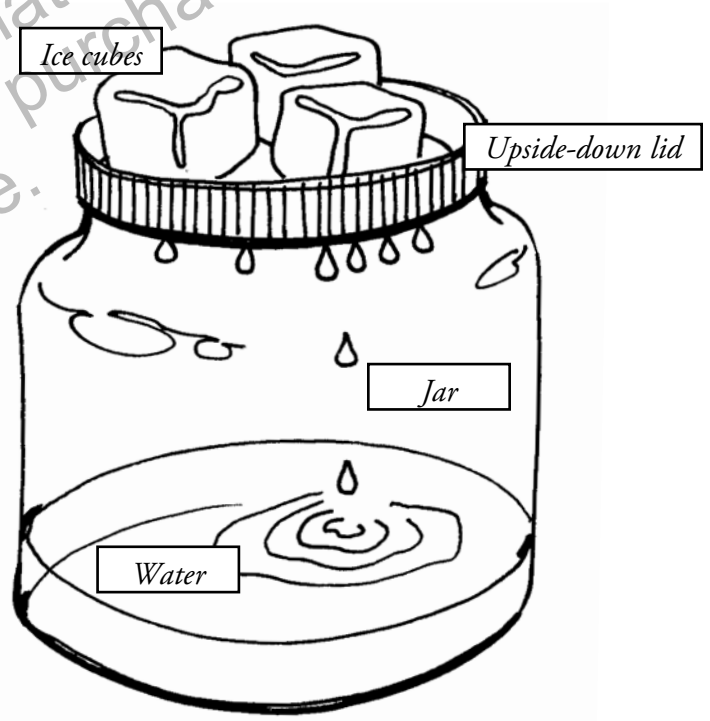
In this experiment, you can observe the water cycle in a short period of time. You will be able to observe evaporation, condensation, and precipitation in just 10 minutes.

Materials

- 1 glass jar with a lid (metal lid preferred)
- 3 ice cubes
- hot water to cover the bottom of the jar
- paper and pencil to record observations

What To Do

1. Pour hot water into the jar to a depth of one-half to one inch.
2. Turn the lid upside down and place it on top of the jar.
3. Place the three ice cubes on top of the lid.
4. Record what you see for the next 10 minutes.
5. After 10 minutes, take the lid off and observe the underside of the lid.
6. Record your observations again.



– Interpret –
Explain the results of the data you collected.

Glossary

gases—matter that has no shape; gases spread out to fill the space around them; most cannot be seen

liquid—a state in which matter flows freely when poured; liquids take the shape of whatever holds them

reservoirs—places where water is stored

thunderstorm—a rainstorm that has thunder and lightning

vapor—a gas formed from something that is usually a liquid

To Find Out More . . .

Want to learn more about water?

Try these books

A Drop Around the World by Barbara McKinney Shaw. Dawn Publications, 1998.

The Magic School Bus Wet All Over by Pat Relf and Carolyn Bracken. Scholastic, 1996.

Access these Web sites

The National Weather Service
http://www.nws.noaa.gov/

The Environmental Protection Agency, Office of Water
http://www.epa.gov/water/

Write for more information

The National Weather Service
1325 East West Highway
Silver Spring, MD 20910

U.S. Environmental Protection Agency
Office of Water (4101M)
1200 Pennsylvania Avenue, N.W.
Washington, D.C. 20460

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Earth Science

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Advanced Level

Assessments

Water Is in the Air

Water Is in the Air

Check Understanding

Shade the circle next to the correct answer or write your answer on the lines.

1. What is necessary for hail to form?

   Ⓐ The storm must be moving from west to east.

   Ⓑ There must be a mixture of rain, snow, and sleet.

   Ⓒ The air temperature must remain at freezing point.

   Ⓓ There must be warm updrafts and cold downdrafts.

2. The water cycle is made up of five parts. Which list shows the correct order of these parts in the water cycle?

   Ⓐ evaporation, precipitation, condensation, runoff and groundwater, transportation

   Ⓑ evaporation, transportation, condensation, precipitation, runoff and groundwater

   Ⓒ precipitation, transportation, runoff and groundwater, evaporation, condensation

   Ⓓ precipitation, condensation, transportation, runoff and groundwater, evaporation

3. Identify one place water is stored on Earth. [1]

   _____

   Explain what will happen to the water next. [1]

   _____

   _____

   _____

   _____

Water Is in the Air

Check Understanding

Shade the circle next to the correct answer or write your answer on the lines.

4. Identify **two** forms of precipitation that return water to Earth's surface. [1]

   1) _____

   2) _____

   Explain what conditions must exist for them to occur. [2]

   _____

   _____

   _____

   _____

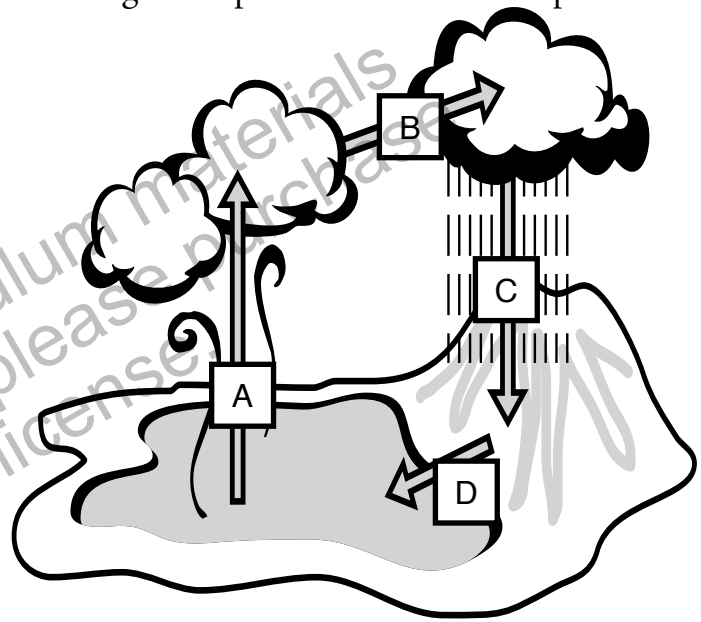
   _____

   _____

   _____

   _____

5. The following diagram shows the water cycle. The letters A through D represent four different processes taking place.



In the chart, write the letter in the diagram that matches each process. [1]

Process	Letter
Runoff	
Condensation	
Precipitation	
Evaporation	

Water Is in the Air

Assessment Scoring Guidelines

1. Answer D is correct.
2. Answer B is correct.
3. Oceans
   The water will be stored until it evaporates.

   Reservoirs
   The water will be stored until it evaporates (or) The water will be used for drinking, cooking, and cleaning.
4. Rain
   Water falls as rain when temperatures are above freezing.

   Snow
   Water falls as snow when it freezes while still in the cloud.

   Sleet
   Water falls as sleet when it freezes, then melts, then freezes again.

   Hail
   Water falls as hail when it freezes then starts to melt but is blown back up into colder air many times.
5.

Process	Letter
Runoff	D
Condensation	B
Precipitation	C
Evaporation	A

Earth Science

Water

Advanced Level

English Language Arts Activities

Water Is in the Air

Cause and Effect

A cause explains why something happens. An effect describes what happens as a result of a cause. Sometimes the cause is stated first in a sentence, but sometimes the effect is first.

The words *because, if, so,* and *when* are often used to state cause and effect. Read this sentence from *Water Is in the Air* and try to identify cause and effect. Notice that a comma separates the cause and effect.

When water is warmed by the sun, it evaporates and rises.

Which is the cause?

water is warmed by the sun

This phrase tells why the water evaporates and rises.

Which is the effect?

the water evaporates and rises

This phrase tells what happens.

TRY THE SKILL

Use the phrases in the table to form six sentence showing cause and effect. Be sure to begin at least one sentence with a cause and at least one with an effect.

Causes	Effects
when these droplets are packed close together	the cloud can no longer contain all the water, and it falls
as snow falls to Earth's surface	each flake has a beautiful, unique pattern
when enough water collects in a cloud	it remains frozen
because the water evaporates	the ground can become dry and dusty
his glasses fogged up	they become visible and form a cloud
because snow freezes in a cloud and stays frozen as it falls	so he could barely see

Question and Answer

You can monitor your understanding of what you read by asking questions about the topic and then reading to find the answer. Sometimes authors will even write a question in the text and then answer it.

Read the paragraph from *Water Is in the Air*.

Snow is water that freezes while it is still in a cloud. As it falls to Earth's surface, it remains frozen. Because snow freezes in a cloud and stays frozen as it falls, each flake has a beautiful, unique pattern. The patterns are created by the air that mixes with the cloud when the snowflake freezes.

What is the question?

What is snow?

What is the answer?

Snow is water that freezes in a cloud. As it falls, it stays frozen. Each flake has a beautiful, unique pattern. The patterns are created by the air that mixes with the cloud when the snowflake freezes.

TRY THE SKILL

Read the question from *Water Is in the Air*. Write an answer in your own words.

Where do you imagine you can see water stored on Earth?

Now think of another question you could ask based on *Water Is in the Air*. Then, write an answer in your own words.

Roots and Suffixes

Understanding roots and suffixes can help you understand the meanings of words and increase your vocabulary. The following table shows the meaning of different suffixes.

Suffix	Meaning	Example
-ed	Makes a verb past tense	Evaporated—The water evaporated yesterday.
-ing	Makes a verb ongoing	Evaporating—Lakes are constantly evaporating.
-tion	Makes a verb a noun	Evaporation—Evaporation occurs when something wet dries.

What form of the word *condense* should you use in the following sentences?

_____ occurs when water in the air forms tiny water droplets. The water is _____ from a gas to a liquid, which is an important part of the water cycle. Water in a cloud is water that has _____.

Suffixes show that the first word is a noun, the second is an ongoing verb, and the third is a past tense verb.

Condensation occurs when water in the air forms tiny water droplets. The water is condensing from a gas to a liquid, which is an important part of the water cycle. Water in a cloud is water that has condensed.

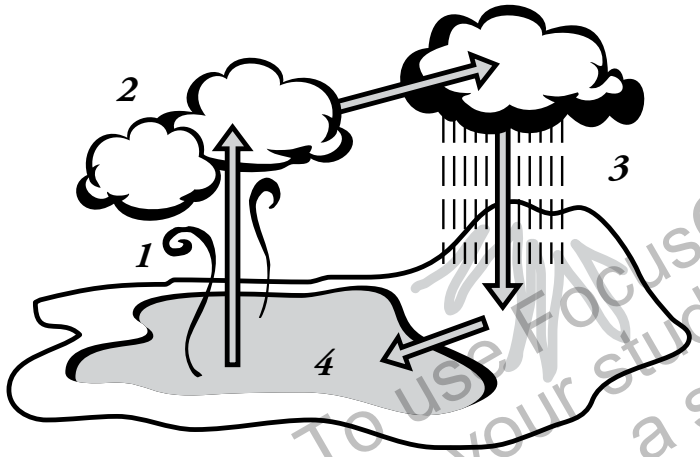
TRY THE SKILL

Read the roots and suffixes. Write sentences in the chart that combine the roots and suffixes. The first one is done for you.

Root	Suffix	Sentence
Precipitate	-ing	When it is raining, snowing, or sleeting, it is precipitating.
	-ed	
	-tion	
Collect	-ing	
	-ed	
	-tion	

Interpret Graphic Information

Graphic information can help you understand a process. The following illustration shows the water cycle. The steps in the process are numbered.

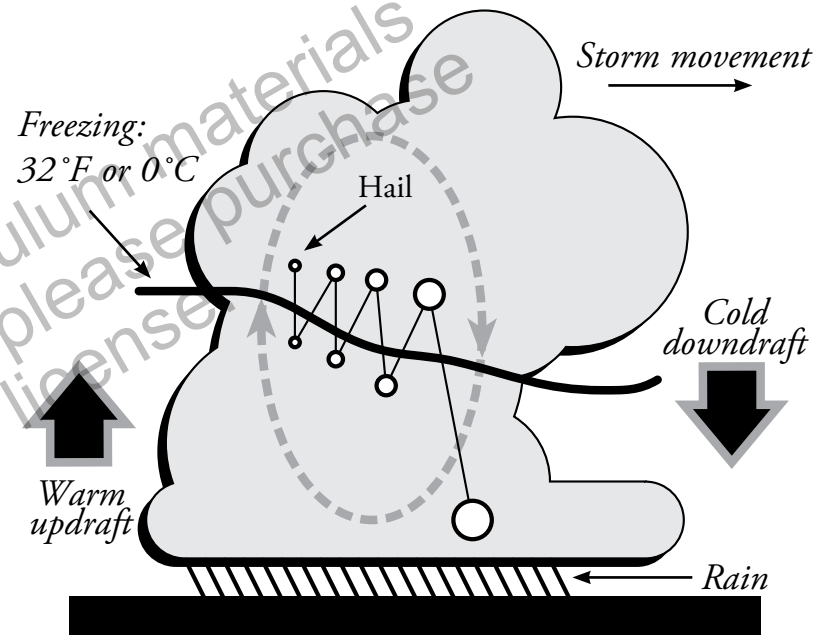


The picture can remind you of the steps in the water cycle. For example, you might look at this diagram and then write the following:

Water evaporates and rises into the air. Next, water cools and condenses. Then, water falls as precipitation. Then, water is collected in lakes, rivers, oceans, or underground. Finally, the water cycle repeats itself.

TRY THE SKILL

Look at the diagram and write about how hail forms.



Answer Key

Cause and Effect

1. When these droplets are packed together, they become visible and form a cloud.
2. As snow falls to Earth's surface, it remains frozen.
3. When enough water collects in a cloud, the cloud can no longer contain all the water, and it falls.
4. Because the water evaporates, the ground can become dry and dusty.
5. His glasses fogged up, so he could barely see.
6. Because snow freezes in a cloud and stays frozen as it falls, each flake has a beautiful pattern.

Question and Answer

Possible answer: Water might be found in lakes, rivers, oceans, underground, or in reservoirs.

Roots and Suffixes

Sentences will vary.

Interpret Graphic Information

Answers will vary, but should include the fact that hail moves up and down in a storm cloud. It grows larger and larger each time it passes through air that is above and below freezing.